

4. PRODUCTION, IMPORT, USE, AND DISPOSAL

4.1 PRODUCTION

Barium is a dense alkaline earth metal which occurs naturally in ore deposits and makes up 0.05% of the earth's crust (Kojola et al. 1978). Barium and its compounds may be found in nature or produced industrially for various uses. The largest natural source of barium is barite ore which is composed largely of barium sulfate and found in beds or masses in limestone, dolomite, shales and other sedimentary formations (Miner 1969b). Crude barite is then turned into crushed barite which not only has its own industrial uses but which also serves, in turn, as the source for the production of other barium compounds. Crushed barite is first converted to barium sulfide by hightemperature, solid-phase reduction with a carbonaceous reducing agent. Barium sulfide is the starting point for the chemical manufacture of most other barium compounds (Kirkpatrick 1985). One such useful compound is lithophone consisting of 28% zinc sulfide (ZnS) and 72% barium sulfate (BaSO_4). Barium sulfate is produced from high-grade (75%-98%) ore in association with granite and shale, is then crushed, and then beneficiated by froth flotation ,or by jigging, and dried (Stokinger 1981). Barium carbonate, also used to be mined from the earth as witherite (Hayes 1982), however, it is no longer mined commercially (Bodek et al. 1988).

Barite occurs in abundance in Alaska, Arkansas, California, Georgia, Missouri, Nevada, and Tennessee as well as in Canada and Mexico. This substance was produced at 38 mines in seven U.S. states in 1973. Total U.S. production for 1973 was 1,104,000 tons, a figure which represented 23% of world production. Nevada supplied 50% of this total with Missouri ranking second in domestic production of barite ore. Domestic production levels for 1969 were much lower at 603,000 tons (Davis 1972). A list of barium production and processing facilities in the United States along with the production or processing volume for each are provided in Table 4-1.

4.2 IMPORT/EXPORT

For the year 1969, U.S. imports of barite ore totaled 344,000 tons, and the export volumes were at 10,000 tons (Davis 1972). Import levels for 1973 were 716,000 tons while exports of barium sulfate and carbonate reached about 68,000 tons (Stokinger 1981). Import and export levels both increased significantly from 1969 to 1973.

4.3 USE

Barium and its compounds are used in oil and gas drilling muds, automotive paints, stabilizers for plastics, case hardening steels, bricks, tiles, lubricating oils, and jet fuel as well as in various types of pesticides (Bodek et al. 1988; EPA 1982; Venugopal and Luckey 1978). The

4. PRODUCTION, IMPORT, USE, AND DISPOSAL

TABLE 4-1

Facilities That Manufacture or Process Barium and Compounds^a

State ^b	No. of facil- ities	Range of maximum amounts on site in thousands of pounds ^c	Activities and uses ^d
AL	9	1-999	2, 3, 7, 8, 9, 13
AR	2	1-99	9
AZ	3	10-9,999	6, 11, 12
CA	34 (2) ^e	0-999	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13
CO	4	1-999	2, 8, 9, 13
CT	10	0.1-999	1, 2, 3, 4, 7, 8, 9, 10, 11, 13
DE	1	10-99	1, 4, 7
FL	3 (1) ^e	1-99	7, 8, 9
GA	12 (2) ^e	0-49,999	1, 2, 3, 4, 7, 8, 9, 12
IA	11	0.1-99	8, 9, 13
ID	2	10-9,999	1, 5, 8, 12
IL	29 (1) ^e	0.1-49,999	1, 2, 3, 7, 8, 9, 10, 12
IN	16	0-999	1, 3, 4, 7, 8, 9, 11
KS	3	1-99	8
KY	16 (1) ^e	0-999	2, 7, 8, 9
LA	10 (1) ^e	0-499,999	1, 2, 4, 7, 8, 9, 10
MA	7	10-99	1, 3, 4, 8, 9, 10, 12
MD	8	1-999	1, 3, 4, 7, 8, 9, 11
MI	38 (5) ^e	0.1-999	1, 2, 3, 4, 7, 8, 9, 11, 12, 13
MN	4	1-99	6, 8, 12
MO	16	1-499,999	4, 5, 7, 8, 9, 10, 11
MS	4 (1) ^e	0-99	2, 8, 9, 12

4. PRODUCTION, IMPORT, USE, AND DISPOSAL

TABLE 4-1 (Continued)

State ^b	No. of facilities	Range of maximum amounts on site in thousands of pounds ^c	Activities and uses ^d
NC	15	0.1-999	2, 7, 8, 9, 11, 12
ND	2 (1) ^e	10-99	9
NE	4	1-999	2, 7, 8, 9, 13
NJ	32 (4) ^e	0.1-9,999	1, 2, 3, 4, 7, 8, 9, 10, 11, 12
NM	1	10-99	12
NV	1	10-99	4, 10
NY	28 (1) ^e	1-99,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
OH	76 (4) ^e	0.1-999	1, 2, 3, 4, 6, 7, 8, 9, 10, 12, 13
OK	10	0-999	2, 3, 7, 8, 9, 11, 12
OR	2	10-99	2, 9, 11, 13
PA	39 (2) ^e	0-9,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
PR	1	10-99	1, 4, 7
RI	2 (1) ^e	10-99	3, 7, 8
SC	6 (1) ^e	1-999	1, 5, 8, 9, 12, 13
TN	10 (1) ^e	1-9,999	1, 3, 5, 7, 8, 9, 11, 13
TX	34 (5) ^e	1-99,999	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
UT	6 (1) ^e	10-99,999	1, 2, 5, 8, 9, 10, 12, 13
VA	9	0-999	7, 8, 9
VT	2	1-99	12

4. PRODUCTION, IMPORT, USE, AND DISPOSAL

TABLE 4-1 (Continued)

State ^b	No. of facilities	Range of maximum amounts on site in thousands of pounds ^c	Activities and uses ^d
WA	3	1-999	2, 8, 9, 12
WI	10	1-999	1, 3, 4, 7, 8, 9, 11, 12
WV	4	1-999	8, 11, 12

^aTRI 1989^bPost office state abbreviations^cData in TRI are maximum amounts on site at each facility.^dActivities/Uses:

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|-------------------------------|----------------------------------|
| 1. produce | 8. as a formulation component |
| 2. import | 9. as an article component |
| 3. for on-site use/processing | 10. for repackaging only |
| 4. for sale/distribution | 11. as a chemical processing aid |
| 5. as a byproduct | 12. as a manufacturing aid |
| 6. as an impurity | 13. ancillary or other use |
| 7. as a reactant | |

^eNumber of facilities reporting "no data" regarding maximum amount of the substance on site.

4. PRODUCTION, IMPORT, USE, AND DISPOSAL

largest use of mined barite, which accounts for 85%-95% of the total output is oil and gas well drilling (Bodek et al. 1988; Stokinger 1981). The rest of barite ore (or crude barium sulfate) is utilized frequently in the paint, glass, and rubber industries as well as in the production of other barium compounds. Such barium compounds as the carbonate, chloride, and hydroxide are important in the brick, ceramic, photographic, and chemical manufacturing industries (Bodek et al. 1988).

Industrial uses of barium and its compounds are wide and varied. Barium metal and its alloys, for example, are often used as "getters" to remove gases from vacuum tubes due to their ability to absorb gases (Stokinger 1981). One of barium carbonate's major uses is as a rodenticide (Meister 1989; Worthing 1987), however, it also plays an important role in the brick, tile, ceramics, oil drilling, and chemical manufacturing industries (ILO 1983; Kirkpatrick 1985). Barium sulfate, in the chemically treated, blanc fixe form, is used in high-quality paints as well as in glass- and papermaking (ILO 1983). The chloride is used for chlorine and sodium hydroxide manufacture, as a flux for aluminum alloys, and in pigment and textile dye manufacture. Barium oxide is used to dry gases and solvents, and the hydroxide compound plays a role in glass manufacturing, synthetic rubber vulcanization, sugar refining, and animal and vegetable oil refining. Finally, the main function of barium sulfide is to act as a starting point for the production of a number of other barium compounds (ILO 1983; Kirkpatrick 1985).

Barium and its compounds have several important medical uses as well. Barium chloride was formerly used in treating complete heart block, because periods of marked bradycardia and asystole were prevented through its use. This use was abandoned, however, mainly due to barium chloride's toxicity (Hayes 1982). Characterized by extreme insolubility, chemically pure barium sulfate is non-toxic to humans. It is frequently utilized as a benign, radiopaque aid to x-ray diagnosis, because it is normally not absorbed by the body after oral intake (Doull et al 1980; ILO 1983; Rae 1977). In addition to the extensive use of barium sulfate in studying gastrointestinal motility and diagnosis of gastrointestinal disease, barium sulfate may be chosen as the opaque medium for the x-ray examination of respiratory and urinary systems as well (ILO 1983; Sacchetti 1972). Moreover, the literature suggests that radioactive isotopes of barium, such as ^{135m}Ba , ^{131}Ba , and ^{140}Ba , may prove very useful in studying skeletal metabolism as bone-scanning agents (Hayes 1982; Spencer et al. 1971).

4.4 DISPOSAL

In case of a spill, it is suggested that persons not wearing protective equipment be restricted from the area. Furthermore, ventilation should be provided in the room and the spilled material collected in as safe a manner as possible. Barium compounds (particularly soluble ones) should be placed in sealed containers and reclaimed or disposed of in a secured sanitary landfill (Joseph 1985; NIOSH/OSHA 1978). It is also suggested that all federal, state,

4. PRODUCTION, IMPORT. USE, AND DISPOSAL

and local regulations concerning barium disposal should be followed (HSDB 1989). No other guidelines or regulations concerning disposal of barium and its compounds were found.